Virtual Reality in Education

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Abstract: Virtual reality is a human-designed system with the help of computer and electronic devices such as cameras and sensors to interact with 3-D environments. Many challenges that educators face in online teaching can be addressed by using VR. VR can provide learners with an immersed environment where otherwise students cannot access. VR is an exciting way for turning ordinary classrooms into places of wonder, inquiry, and adventure. VR increases student's engagement and interest in learning. It makes many hard topics easy by 360-degree realistic view. This paper provides an introduction to virtual reality.

Keywords: virtual reality, education.

INTRODUCTION

Education is the foundation for a thriving society, and the transfer of knowledge has been a top priority for civilizations since the very beginning. Educators over the years have constantly searched for ways to make knowledge transfer more easily and more effectively. Gone are the days when a simple chalkboard would suffice for instruction in the classroom. Today, various methods and tools are used in the educational system as educators use all sorts of breakthrough technology as primary mediums of instruction. Virtual reality has emerged as a tool that helps improve the learning process. It helps the students to study their content and increases student engagement in studies.

Human beings are visual creatures. Both hearing and seeing are central to our sense of space. As we have been spending an increasing amount of time in front of computers, the need for exploring more of the role of virtual environments needs to be increased as well. Virtual reality is the key technology for experiencing sensations of sight, hearing, and touch of the past, present, and future. VR is a fully immersive technology where users wear a head-mounted display and experience a simulated world of imagery and sounds. VR enables active learning,

CONCEPT OF VIRTUAL REALITY

The term "virtual reality" essentially means "near-reality." Virtual reality has been known by different names such as synthetic environment, cyberspace, artificial reality, virtual environments, and simulator technology. The two terms, "virtual reality" and "cyberspace" are often used interchangeably. A cyberspace may be regarded as a networked virtual reality. Virtual reality is a simulated experience that can be similar to or different from the real world. It is a computer generated, 3D environment that completely immerses the senses of sight, sound, and touch. The complete immersion of the senses literally overwhelms users, totally engrossing them in the action [1].

Virtual reality (VR) describes a three-dimensional (3D), computer generated environment which can be explored and interacted with by a person. Once entered, it becomes reality to the person. Instead of viewing a screen in front of them as when using traditional interfaces, users are immersed and able to interact with 3D worlds.

Based on data entered by programmers, computers create virtual environments by generating 3D images. Users can view these images by using a head-mounted device, which can be a helmet or goggles. Mobile VR glasses enable users to be present in any environment they want at any time and at any place. Users may use a joy stick or track ball to move through the virtual environment. A person using virtual reality equipment can dive into a complete, fully immersive 3D environment, look around the artificial world, move around in it, and interact with virtual objects. The virtual environment can be viewed using a cell phone screen, monitor, projector, or head-mounted display (HMD). As the person is immersed in the computer-generated environment, the brain is deluded into thinking the virtual world is reality.

VR has three main characteristics [2]: interaction, immersion, and imagination. Interaction refers to the natural interaction between the user and the virtual scene. Immersion means that the user feel that they are part of the virtual world as if they are immersed. Imagination refers to the use of multi-dimensional perception information provided by the VR scenes.

Virtual reality technology includes multiple components which can are divided into two main groups: the hardware components and the software components [3].

➢ *Hardware Components:* The hardware components consist of computer workstation, sensory displays, tracking system, wearable devices, and input devices. Sensory displays are used to display the simulated virtual worlds to the user. The most common type is the head-mounted displays (HMDs), which is used in combination with tracking systems. Head-mounted displays are shown in Figure 1 [4] . Users interact with the simulated environment through some wearable devices. VR depends on special responses such as raising hands, turning the head, or swinging the body. A wearable device is important in making these effects realistic. Special input devices are required to interact with the virtual world. These include the 3D mouse, the wired glove, motion controllers, and optical tracking sensors. These devices are used to stimulate our senses together in order to create the illusion of reality.

➢ *Software Components:* Besides the hardware, the underlying software plays a very important role. It is responsible for the managing of I/O devices and the time-critical applications. The software components are 3D modeling software, 2D graphics software, digital sound editing software, and VR simulation software. VR technology has been designed to ensure visual comfort and ergonomic usage.

VIRTUAL REALITY FOR EDUCATION

VR technologies are being applied in various disciplines including healthcare, law, engineering, business, social sciences, education and training, simulation, marketing, commerce, architecture, arts, sport, fashion, engineering, construction, environmental navigation, factory, tourism, archaeology, military, media, music, cinema, scientific visualization, telecommunication, and programming languages. We consider the applications of VR in various disciplines in education.

➢ *Elementary Schools:* There are possibilities for bringing the curriculum to life using virtual reality experiences. Students in elementary schools participate in immersive education with the help of virtual reality applications. Educators are taking students on virtual field trips to give them exposure to the real world without going outside the campus. Assistive technology can be used for students with special needs. Parents can take their children anywhere around or inside the world [6]. VR enables students to simply grasp what they struggle to know when being taught by their teachers. Figure 2 shows how VR is used in teaching children [7]. VR is also useful for students in high school, colleges, and universities.

➢ *Medical Education:* Schools of medicine in different parts of the world are among the most ardent VR technology supporters. VR technologies have been used for treating several mental disorders such as anxiety disorders. Dental healthcare issues are becoming increasingly important due to the crisis of aging populations. VR can be used as an effective treatment of patients with dental phobia, a common problem in our society. Concerning medical education, several requests have been made to eliminate outdated, inefficient, and passive learning approaches and embrace newer methodologies of learning such as VR. The use of VR devices allows learning to occur through hands-on immersive experiences. They are ideal for training in hands-on procedures without harming actual patients. VR is becoming useful for training physicians through visual simulation technology. It can be used to train medical students and resident physicians for surgeries in a risk-free environment without physically being in an operating room. VR trainers are available for various medical procedures. VR technologies will play an increasing role in teaching, surgery, learning anatomy, anesthesia, and dentistry. Physicians can produce a three dimensional model of a particular patient's anatomy and map out the surgery ahead of time. Figure 3 shows virtual reality in surgery [7].

➢ *Distance Education:* Schools are leveraging VR technology to help facilitate distance learning. Some educational applications can be accessed from anywhere using just a smartphone and an Internet connection. Such applications keep the learners connected and they do not need to be physically present in the institution. This removes the barrier of location and time as they can learn by using the application anytime anywhere. Students can rewatch such pre-recorded virtual graphics as many times as they want and at their pace using the appropriate devices. Distant educators can share their ideas and communicate virtually [8]

➢ *Special Education:* Having other special educational needs and disabilities (SEND) can affect a student's learning ability in various ways. Virtual reality technology makes it possible for teachers to create personalized educational content that can tailor to these students' unique needs. For SEND students, simply moving around and getting involved in some activities can be very stressful. Immersive VR experiences can be calming for students [9].

➢ *Virtual Field Trips*: Field trips are becoming a vital part of a child's education. They provide exposure and practicality to the students. However, in certain cases, the field trips do not possibly take place due to COVID-19. In other cases, certain trips are too expensive for all the students to be a part of. Virtual field trips have become one of the most popular applications of VR technology for education. They offer a cost-effective option for schools. VR has become one of the best applications in learning as the students can travel any place in the world without moving a step aside from their seats. It can be a great opportunity to take the travel and tour experience without actually visiting the place. They can see the realistic graphic-based images and have the views of the place. All this is possible with VR technology without even leaving the classrooms [8]. Figure 4 shows how Google expeditions enable virtual field trips all over the world [10].

➢ *Virtual Campus Visits:* Many schools have started using virtual reality campus tours as a way to connect with applicants to university campuses. These campus 'visits' allow students to see what it would be like to attend universities in other cities and countries even if they cannot visit in person. The virtual reality tours use photos and videos of campuses and their surroundings that enable students to explore the campuses at 360-degree angles [11].

BENEFITS

A key benefit of using VR in education is that you learn through experience. VR enables students to experience real scenarios or fabricated experiences over and over, and learn in an immersive way. Both students and teachers are embracing the rapid developments in virtual reality. Virtual reality presents endless opportunities in the field of education. Virtual reality

makes the educational impact and learning root deeper than the traditional methods. With all the advantages of virtual reality, it will soon become a standard tool in education. Some of its advantages include the following [12]:

➢ *Increase memory power and knowledge retention*

➢ *Boost excitement and engagement in the classroom*

➢ *Improve learning outcomes*

➢ *Focus student attention on the lesson*

➢ *Open up new opportunities and create accessibility for every student*

➢ *Improve understanding of complex, conceptual subjects*

➢ *Build emotional intelligence, awareness, and understanding*

➢ *Improve communication and collaboration skills*

➢ *Make learning more interesting*

➢ *Add a new level of learning to lessons*

➢ *VR* makes demonstration of practical skills easier.

CHALLENGES

The benefits of virtual reality in education are embraced by many educators, but some are still reluctant to use it in their classrooms. VR critics argue that it is too expensive, too challenging to implement, and too distracting for students. Other challenges include [13]:

➢ *Bad quality headsets can cause discomfort in the form of motion sickness and headaches.*

➢ *Avoid limiting the number headsets per class to reduce cost; this can result in poor educational experiences*

➢ *Poor Internet connectivity will result in visual lag*

➢ *High cost is a major barrier to its adoption in education*

➢ *There is lack of content and developing more content can be very expensive*

➢ *Some students that do not have the money to buy a VR headset.*

➢ *Cyber-sickness can prevent students from learning*

Despite these challenges, demand for VR in education will grow in the coming years.

CONCLUSION

Virtual reality is produced by a combination of technologies that are used to visualize and provide interaction with a virtual environment. It allows a user to interact with a computer generated 3D model or virtual environment. In 3D virtual reality, the interaction with computers is expanded from purely visual interaction to diverse interaction.

VR has opened several opportunities in the education sector for students and teachers. It is transforming education in smart classrooms around the world. Although virtual reality has existed in the realm of education for over half a century, its widespread adoption is still yet to take place. This is due to some limitations of the VR technology itself, and the costs and logistics required to deploy it. Virtual reality applications in education have emerged as rapidly developing technologies that have the potential to change education. Many teachers and students believe VR deserves a place in today's classrooms. For more information the applications of virtual reality in education, one should consult the books in [14-23].

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Figure 1 Head-mounted displays [4].

Figure 2 VR is used in teaching children [6].

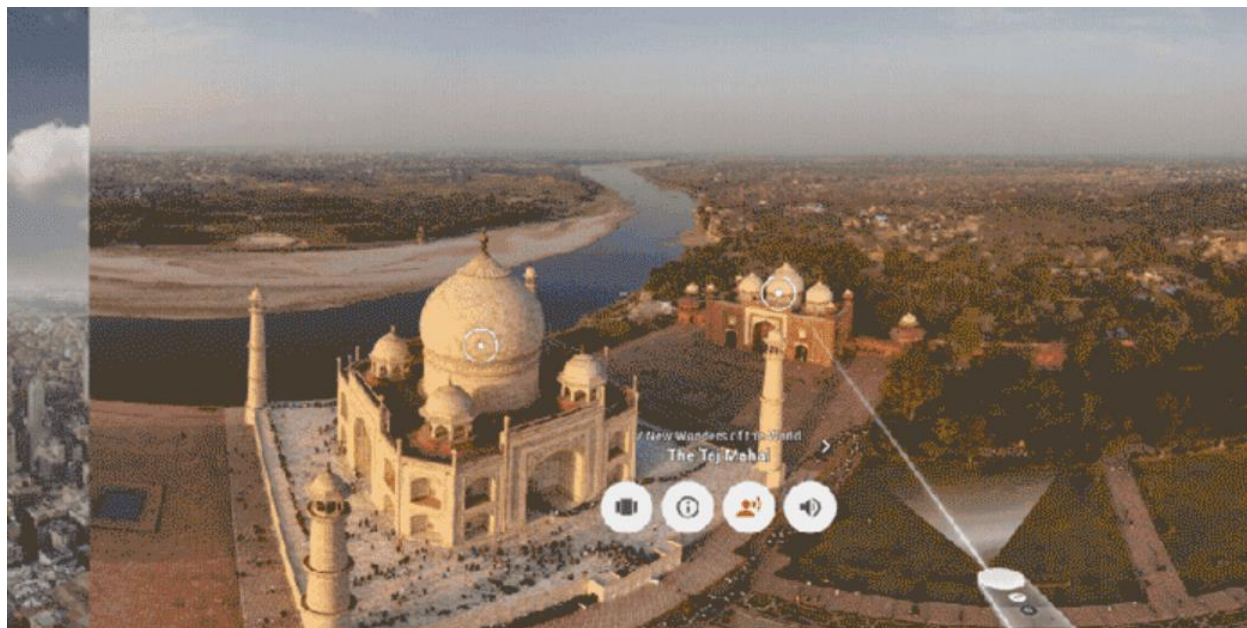Figure 3 Virtual reality in surgery [7].

Figure 4 Google expeditions enable virtual field trips all over the world [10].